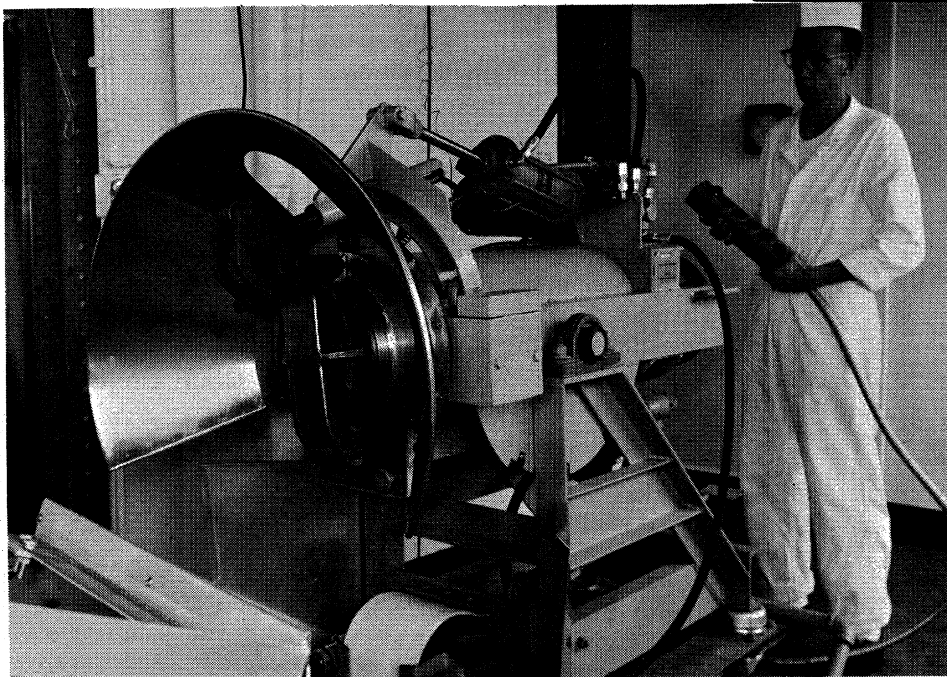


**PUFFING GUN**, designed specifically for fruits and vegetables, has 10-in. diam and is 30 in. long, and is shown here in position for rotation.



## Superheated Steam Aids Explosive Puffing

In making quick-cook dehydrated products, superheated steam supplements external heating of puffing gun.

Process for diced carrots is described

**EXPLOSIVE PUFFING** of fruits and vegetables to produce quick-cooking dehydrated products has received wide publicity (1, 2, 3, 4, 5, 6). The apparatus originally employed was an externally heated "gun" of the type used in cereal puffing. It was ill-suited to the new process because of its massive construction and low capacity.

A gun specifically for fruits and vegetables has now been designed (7, 8). It is 10 in. in diameter, 30 in. long (see photo).

In contrast to cereal-puffing guns, the barrel is thin gauge, the lid is lightweight and capable of rapid opening at low pressures.

And the heating surface per unit volume is increased by internal ribs, integral with the shell. That permits quicker come-up time, better puffing, and approximately a doubled capacity.

The gun has also been equipped for the introduction of superheated steam to supplement external heating with gas burners. The overall results are larger charges and a marked increase in the number of charges that can be processed per hour.

Somewhat different conditions of operation are required with this gun than have been previously described where external heating

alone was used. In general, the material is charged to the gun at a lower moisture than previously, since some slight steam condensation may take place.

To minimize condensation, the charge is pre-warmed by tumbling in the gun at a predetermined shell temperature for approximately 1½ min. The superheated steam is then admitted and external heating is continued until the desired pressure is reached, usually in about 1 min. These conditions are maintained for ½ min, before discharging.

### Working With Carrots

For carrot pieces, e.g., ¾-in. dice, the optimum puffing conditions are as follows: The pieces,

prepared as previously described (2), should be dried in hot air by any conventional means to a moisture content between about 20 and 30%.

The gun temperature, as measured by a sliding thermocouple on the external surface, is brought to between 340 and 350F by externally heating the rotating empty gun. Rotation is stopped, the gun is tilted to charging position and a 20-lb charge is put in.

After tilting to a horizontal position, rotation is immediately started and the shell temperature is maintained between 340 and 350F with the gas burners for 1½ min. Experience has shown that the charge will then have reached such a temperature that no objectionable amount of condensation takes place upon admitting the steam.

Steam is admitted—superheated to a temperature somewhat above that of saturated steam at 35 lb per-sq-in. gage pressure (305F). Since some heat loss is inevitable between the outlet of the superheaters and the point of entrance to the pressure chamber of the gun, the steam may have to be heated as high as 500F. That ensures slightly superheated steam actually entering the gun. A small aperture in the lid permits escape of air and allows steam to flow, thereby accelerating heating.

The pressure in the gun will reach 35 psig in about 1 min. Operation is continued for ½ min after pressure has been reached. The gas is then turned off, the gun is tilted to 22½ deg below the horizontal, which is the nor-

mal firing position, and the lock on the lid is then tripped.

The charge, with its water content slightly superheated, bursts from the gun and acquires a porous structure because some of the superheated water flashes instantly into vapor. The steam is turned off immediately after firing.

## Drying Within Limits

The puffed product is then dried in hot air employing conditions already described (2). The time to dry to 4% moisture is about one-half that required for unpuffed pieces. Although puffing may be accomplished using carrots below about 20%, no useful purpose is served thereby. Experience has shown that drier products merely regain more moisture in the gun.

Moreover, when the moisture in the material to be puffed is below about 20%, scorching occurs and the rehydration ratio tends to fall off. Obviously, puffing should be done at the highest feasible moisture in order to take advantage of the accelerated drying rate of puffed products.

The performance of this gun on a pilot plant scale has been so satisfactory that it is believed to be suitable for commercial use—especially in small operations where flexibility is desired and a variety of commodities is being processed. Construction drawings of the unit are available by writing to Eastern Utilization Research and Development Division, 600 East Mermaid Lane, Philadelphia, Pa. 19118. (End)

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